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Autonomous and forced dynamics in a spin-transfer nano-oscillator: Quantitative magnetic-resonance force microscopy

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Abstract

Using a magnetic-resonance force microscope (MRFM), the power emitted by a spin-transfer nano-oscillator consisting of a normally magnetized Py|Cu|Py circular nanopillar is measured both in the autonomous and forced regimes. From the power behavior in the subcritical region of the autonomous dynamics, one obtains a quantitative measurement of the threshold current and of the noise level. Their field dependence directly yields both the spin torque efficiency acting on the thin layer and the nature of the mode which first auto-oscillates: the lowest energy, spatially most uniform spin-wave mode. From the MRFM behavior in the forced dynamics, it is then demonstrated that in order to phase lock this auto-oscillating mode, the external source must have the same spatial symmetry as the mode profile, i.e., a uniform microwave field must be used rather than a microwave current flowing through the nanopillar.

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